Camp Robin

Fire and Fuels Report

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Introduction

Summary

The fire and fuels analysis for the Camp Robin Project describes the potential fire behavior that could be expected under severe conditions (97th percentile weather and fuel conditions[1]) and how this affects potential severity of fire within the project area for two alternatives: alternative 1 (no-action) and alternative 2 (the proposed action). Fire modeling was used to address fire behavior at the landscape level. Three fire behavior indicators were tracked: flame length, rate of spread, and crown fire activity. By implementing the proposed action, the potential fire behavior would be reduced (when compared to alternative 1) for all three fire behavior indicators and would remain so for some time into the future dependent on treatment type. Several values including travel routes, Forest Service developments, private property and homes were identified in the project area. The potential fire behavior near these values would also be reduced with the proposed action. Implementing the proposed action would reduce fire severity as well, providing a safer environment for firefighters and the public and creating a more fire resilient landscape.

Project Development

The Camp Robin Project was developed through the collaborative process of the Kootenai Valley Resource Initiative. The Kootenai Valley Resource Initiative (KVRI) is a community-based, collaborative effort in the Kootenai River Basin whose mission is "to improve coordination of local, state, federal and Tribal programs to restore and maintain social, cultural, economic and natural resources" (http://www.kootenai.org/kvri.html). The Camp Robin Project was developed under the Collaborative Forests Landscape Restoration Project; the project objectives, purpose and need and proposed action were developed through the cooperative efforts of this group.

The entire Camp Robin Project Area falls within the WUI area as defined in the Boundary County Wildland Urban Interface Fire Mitigation Plan (project file). The IPNF recognizes the importance of working in cooperation with counties and their community protection plans to reduce the risk of wildfire and the associated public safety and forest health issues (2015 IPNF Forest Plan, p. 9). The Forest Plan emphasizes the need to reduce hazardous forest fuels in these areas and to maintain fuel conditions, and the pattern of conditions across the landscape, in such a state that there is limited crown fire potential and that the risk is low for epidemic levels of bark beetles, root disease and stand replacement wildfires (2015 IPNF Forest Plan, p. 21-22[2]). The desired condition that is expressed in the Collaborate Forest Landscape Restoration Proposal that was developed by KVRI also stresses the need to reduce hazardous fuels in the WUI (2015 IPNF Forest Plan, p. 10-11).

Private and timber company lands occur within the Camp Robin Project Area. In addition, other non-Forest Service lands occur immediately adjacent to the project area. Dozens of private residences and other structures are scattered throughout the project area and the communities of Copeland, Eastport, and Moyie Springs are located within less than two miles of the project area. In the Forest Plan section for the Lower Kootenai GA, there is specific direction to reduce the

[1] Percentiles are used to define climatological conditions. The 97th percentile weather is defined as the severest 3% of the historical fire weather, such as hot, dry, windy conditions occurring in fire season.
[2] See the following Forest Plan elements: *FW-DC-FIRE-02, 03* and *FW-OBJ-FIRE-01*.

threats of wildfire to certain communities, which include Copeland, Eastport, and Moyie Springs (2015 IPNF Forest Plan, p. 85[3]).

Wildland-Urban Interface and Home Ignitability

Although there is private property and residences within the Camp Robin Project area, the purpose is not to reduce home ignitability, as this project would not address fuels in the home ignition zone. However, the wildland-urban interface can go far beyond the home ignition zone.[4] In Boundary County, the wildland-urban interface is defined as:

> …two miles outside places of human habitation and/or infrastructure to service these points of habitation. Infrastructure includes power and communication lines and towers, transportation routes for ingress, egress and evacuation, rail lines, and watershed where citizen groups have organized for the joint collection of water for domestic use. In instances where topography immediately outside the 2-mile zone would allow 'anchoring' to good fire control points, such as ridge tops or roads, the zone will be extended to the anchor point.
> - Boundary County Community Wildfire Protection Plan, 2003 (Amended 2004).

The Forest Service manages more than 400,000 acres of the forest land in Boundary County. With this deep investment there is a responsibility to work with the local communities and the Boundary County fire mitigation program to reduce fuels and fire behavior on National Forest System (NFS) lands, as there is more at stake than homes.

Regulatory Framework

2015 Forest Plan for the Idaho Panhandle National Forests

The 2015 Forest Plan contains a number of forestwide desired conditions, objectives and guidelines that are applicable to the fire and air quality resources. In addition, the Forest Plan provides some Management Area (MA) specific direction as well as Geographic Area (GA) direction for these resources. That specific direction and how the alternatives would or would not be consistent with that direction, is discussed at length towards the end of this report.

Forest Service Manual

Forest Service Manual (FSM) 5105 (project file) defines fuel as combustible wildland vegetative materials, living or dead. The objective of fuel management as stated by FSM 5150.2 is to identify, develop, and maintain fuel profiles that contribute to the most cost-efficient fire protection and use program in support of land and resource management direction in the forest plan. Methods used for controlling the flammability and intensity of a fire may include mechanical, chemical, biological, or manual means, including the use of prescribed fire (FSM 5150). The Camp Robin Project incorporates several methods to alter fuels to reduce the risk of high severity wildfires and aid in the ability for firefighters to suppress fires.

The Federal Land Assistance, Management and Enhancement Act of 2009

The Federal Land Assistance, Management and Enhancement Act of 2009 (the FLAME Act) was signed by President Obama in November 2009. The Act states, in part, "Not later than one year after the date of the enactment, the Secretary of the Interior and Secretary of Agriculture shall submit to Congress a report that contains a cohesive wildfire management strategy." The FLAME

[3] See the Forest Plan element that is labelled as *GA-DC-FIRE-LK-01*.

[4] an area or location where a wildland fire can potentially ignite homes (Cohen 1999)

Act directs that a cohesive strategy be developed addressing seven specific topic areas ranging from how best to allocate fire budgets at the Federal level to assessing risk to communities, and prioritizing hazardous fuels project funds. The FLAME Act is the catalyst for bringing fire leadership at all levels together and prompting a new approach to how wildland fire is managed. This new approach will guide the development of a national cohesive strategy that paves the way for developing a national wildland fire management policy.

National Cohesive Wildland Fire Management Strategy

In response to requirements of the Federal Land Assistance, Management, and Enhancement (FLAME) Act of 2009, the Wildland Fire Leadership Council (WFLC) directed the development of the National Cohesive Wildland Fire Management Strategy (Cohesive Strategy). The Cohesive Strategy is a collaborative process with active involvement of all levels of government and non-governmental organizations, as well as the public, to seek national, all-lands solutions to wildland fire management issues. The Cohesive Strategy will address the nation's wildfire problems by focusing on three key areas: Restore and Maintain Landscapes, Fire Adapted Communities and Response to Fire.

Three primary factors have been identified as presenting the greatest challenges and the greatest opportunities for making a positive difference in addressing the wildland fire problems to achieve this vision. They are:

- **Restoring and maintaining resilient landscapes.** The strategy must recognize the current lack of ecosystem health and variability of this issue from geographic area to geographic area. Because landscape conditions and needs vary depending on local climate and fuel conditions, among other elements, the strategy will address landscapes on a regional and sub-regional scale.
- **Creating fire-adapted communities.** The strategy will offer options and opportunities to engage communities and work with them to become more resistant to wildfire threats.
- **Responding to Wildfires.** This element considers the full spectrum of fire management activities and recognizes the differences in missions among local, state, tribal and Federal agencies. The strategy offers collaboratively developed methodologies to move forward.

The cohesive strategy was designed to commit to this shared national vision for present and future wildland fire and land management activities in the United States. It will build on the foundation of other efforts to establish direction for wildland fire management in America — the 1995 Federal Wildland Fire Policy and Program Review; the documents that comprised the National Fire Plan; A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment: A 10-Year Strategy; both editions of the Quadrennial Fire Review; Mutual Expectations for Preparedness and Suppression in the Interface; A Call to Action; and Wildland Fire Protection and Response in the United States, The Responsibilities, Authorities, and Roles of Federal, State, Local and Tribal Governments.

The Cohesive Strategy is being implemented in three phases, allowing stakeholders to sys-tematically develop a dynamic approach to planning for, responding to, and recovering from wildland fire incidents. This phased approach is designed to promote dialogue between national, regional and local leadership.

Phase I involved the development of two documents: *A National Cohesive Wildland Fire Management Strategy* and the *Federal Land Assistance, Management and Enhancement Act of 2009 Report to Congress*. These documents provide the foundation of the Cohesive Strategy.

Phase II involved utilizing the process outlined in Phase I, regions will identify values, conduct regional risk assessments and develop strategies to effectively meet local, regional and national goals.

During Phase III, the following steps occurred: Conduct the national analysis. Develop a draft national summary of the regional alternatives. The summary will include a description of the decision space available, a description of the activities and priorities associated with the regional alternatives, and a description of the tradeoffs associated among the alternatives. It will also:

- Share the results of the national results and summarization with stakeholders.
- Update and conclude the analysis based on feedback from the stakeholders.
- Establish a 5-year review cycle to provide updates to Congress.

Methodology

The existing condition and environmental consequences of the alternatives associated with the Camp Robin fire analysis area (42,279 acre project area on Figure 1) were determined using archived fire history data, GIS coverages and associated attributes, and field data collected within the project area and used in fire behavior prediction models. Additional information on tools used and the assumptions and limitations of each can be found in the project file document.

Data Sources, Methods, and Assumptions Used

FlamMap 5.0

FlamMap is a fire behavior and analysis program that computes potential fire behavior characteristics (spread rate, flame length, and fireline intensity) over a given landscape under constant weather and fuel moisture conditions. It was used to determine what potential fire outputs could be under severe (97th percentile) conditions and under average (75th percentile) conditions. FlamMap 5.0 is not a complete fire growth simulation model, but rather a model that provides data for a given set of weather and fuel moisture conditions. More information and assumptions used for FlamMap can be found in the Fire Behavior Modeling Descriptions document in the project file.

Farsite 4

Farsite is a fire behavior and fire growth simulator. It incorporates spatial and temporal information on topography, fuels, and weather. Like FlamMap, Farsite uses a landscape file built from the Landfire data. It is necessary to calibrate this simulator so that outputs are realistic to what would happen on the ground.

Behave Plus v6.0.0

The Behave Plus fire modeling system is a program that is a collection of models that describes fire behavior, fire effects, and the fire environment. Behave Plus was used for this analysis to determine stand level fire behavior in stands before and after treatment. Behave Plus requires inputting fuel model, fuel moistures and slope to determine basic fire behavior outputs. Behave Plus is one of the “standard” fire behavior models used by fire behavior analysts and uses the same algorithms as FlamMap.

Landfire National Data Products

Landfire data, which is also known as Landscape Fire and Resource Management Planning Tools, is a mapping program that has vegetation, fire, and fuel characteristic information. Landfire was developed to provide a comprehensive, consistent, scientifically credible data layers for the entire United States. The data is used in support of natural resource planning and fire management planning, and supplements planning and management activities, including monitoring, that require consistent vegetation data. Landfire provides data such as canopy bulk density which is difficult to measure in the field, fuel model data, and canopy base height. The data is then imported into ArcMap and is also available for use in fire modeling programs.

Field Data

Data was collected on fuel characteristics at the Camp Robin project area. Each stand was visited by a fuels technician and information was collected on the stand characteristics through notes and photos.

Data was also collected on fuel loading in the Camp Robin area. The method used for collection was the photoload sampling technique (Keane and Dickinson 2007). This method involves making visual estimates of fuel loading from a detailed sampling protocol. Information was recorded on data sheets which are available in the project file. With the determination of fuel loading, fire behavior characteristics can be estimated, such as surface fire behavior.

Overview of Issues Addressed

The issues and analysis for the fire topic focuses on how the alternatives would affect forest fuels in the project area and how those effects would indirectly impact the potential behavior of wildfires. More specifically, the analysis concentrates on the condition of the forest fuels in all layers (surface, ladder, and canopy or crown fuels), which contribute to extreme fire behavior (such as crown fire) under periods of high fire danger (97^{th} percentile conditions) typical of a northern Idaho summer - where high temperatures, successive days without rain, seasonally low humidities and the passage of weather fronts producing episodes of high winds can lead to the development of large uncontrollable fires.

In addition, the analysis addresses how the alternatives would affect the continuity of forest fuels- both within individual forest stands as well as across larger landscapes. As discussed in more detail later in this report, the behavior of a wildfire is heavily influenced by how contiguous the fuels are across the landscape.

Issue Indicators

The indicators used to quantify the issues related to fire behavior expected given fuel conditions include:

1. Flame length (feet)
2. Rate of spread (chains per hour)
3. Risk of crown fire
    - Potential crown fire across the landscape

Flame Length

Flame length is related to the fuel loading (how much woody debris and forest litter is accumulated on the ground) and fuel arrangement. How suppression activities are accomplished is directly related to flame length. This indicator determines the potential surface fire behavior initially and over time. Fire suppression tactics relate to flame length which is directly related to fire intensity. As flame lengths increase, so does fire intensity. This is a useful tool to understand firefighting capabilities in safely suppressing wildfire. Flame lengths of 4 feet or less is the threshold at which ground crews (i.e. hand crews) can safely attack a fire by creating a direct line. When flame lengths are greater than 4 feet, equipment such as engines, dozers, and retardant aircraft is needed for safe attack of a fire (NWCG 2165, 2006).

Rate of Spread

Rate of spread is how fast a fire moves across a landscape. This indicator predicts how large a fire can grow in a given amount of time, and can determine how long firefighting resources could contain a fire burning on a landscape. In the analysis, a rate of spread of 5 chains[5] per hour was used to describe the effects of each alternative. Fire suppression crews have line construction production rates based on the type of resource. For example, in project area fuel conditions, a 20-person crew would have the production rate of 4 to 6 chains per hour. For an engine crew, the line production rate would range from 3 to 20 chains per hour (these numbers are highly dependent on access). Fires moving less than 5 chains per hour have a higher likelihood of containment than those moving at a faster rate. Modeling done using the BehavePlus program demonstrates that fire containment is less likely when the fire is moving faster than 5 chains per hour (Project File document 13).

Crown Fire Activity

Crown fire is a fire that occurs in the elevated canopy fuels; that is, it spreads among the trees through the branches (Scott and Reinhardt 2001). The method in which crown fire activity was measured was potential crown fire across the landscape.

The **potential crown fire** activity across the landscape is modeled using the program FlamMap 5.0, which models potential surface fire behavior and crown fire for a given landscape.

There are three types of crown fire which include active, passive and independent. Active crown fire (also called a running or continuous crown fire) is one in which the entire surface and canopy fuel complex is on fire, but the crowning phase remains dependent on heat from the surface fuels for continued spread. Active crown fires are characterized by a solid wall of flame extending from the fuel bed surface on the ground through the top of the canopy (Scott and Reinhardt 2001). An active crown fire by definition consumes the canopy of trees and results in overstory trees dying. Stands that can initiate or sustain a crown fire at lower wind speeds are more prone to crown fire. Critical open wind speeds for crown fire initiation and active spread are stand-specific indicators of fire hazard. Although critical wind speeds were used as indices, the site conditions (surface and canopy fuels, slope steepness), not the weather, are being rated (Scott and Reinhardt 2001). Passive crown fire (also called torching or candling) is when single trees or groups of trees torch out, but solid flame is not consistently maintained in the canopy (Scott and Reinhardt 2001). Independent crown fire is on that burns in canopy fuels without the aid of a supporting surface fire. These type of crown fires are rare and short lived (Scott and Reinhardt 2001). The focus of this report is the active and passive crown fire types.

Fire Behavior - Fire Type and Crown Fire Potential

Certain fire behavior characteristics are more desirable from the perspective of minimizing severe fire effects. Extreme fire behavior, which is characterized by torching, spotting, and crowning, affect the ability of fire managers to successfully meet the goals of fuels management and fire suppression as directed in the forest plan. Safe direct attack suppression by any resource

[5] 1 chain is the equivalent to 66 feet

(firefighter, dozer, aerial resource) is limited once flame lengths reach 11 feet (NFES 2165, NWCG 2006).

Additionally, wide-spread crown and high-intensity surface fires can be damaging to forest resources, such as timber. In the event of a wildfire, desired fire behavior would be surface fire of 4 foot flame lengths or less so that ground crews (hand crews) can directly attack a fire safely. Fuel treatments would decrease surface, ladder, and crown fuels such that lower surface flame lengths would be expected to prevent fire from reaching the canopy through torching (Cochrane et al 2011). If torching into the canopy did occur, spacing between tree crowns would make spread from tree to tree unlikely. Following an initial mechanical treatment, using prescribed fire is considered one of the best methods to reduce surface fuels and modify fire behavior (Graham et al. 1999).

Affected Environment

Existing Condition

Fire History

Fire is the major disturbance factor that produces vegetation changes in our ecosystems (Spurr and Barnes 1980). If the role of fire is altered or removed, this will produce substantial changes in the ecosystem. Fire has burned in nearly every ecosystem and nearly every square meter of the coniferous forests and summer-dry mountainous forests of northern Idaho, western Montana, eastern Washington, and adjacent portions of Canada. Fire was responsible for the widespread occurrence and even the existence of western larch, lodgepole pine, and western white pine (Smith and Fischer 1997). Fire maintained ponderosa pine on sites throughout its range at the lower elevations and killed ever-invading Douglas-fir and grand fir (Spurr and Barnes 1980).

The types of fires that occur in forested ecosystems (Zack and Morgan 1994) include:

- **Lethal fires** – fires that are stand replacing, removing 90 percent or more of the live tree dominant upper canopy layer across more than 90 percent of the stand across a large, relatively uniform scale. These are commonly crown fires that burn with high severity. Local examples of these types of fires are the Sundance and Trapper Peak fires of 1967 that together burned over 80,000 acres in a short time period during drought conditions.
- **Non-lethal fires** – fires that kill 10 percent or less of the dominant tree canopy. A much larger percentage of small understory trees, shrubs, and forbs may be burned back to the ground line.
- **Mixed-severity fires** – fires that commonly burn with variable severity across the landscape, producing irregular, patch mosaics; killing more than 10 percent, but less than 90 percent of the dominant overstory tree canopy. Fire regimes are considered variable – a short return interval non-lethal fire may occur with occasional long interval lethal crown fires.

Fires have been documented in the Bonners Ferry Ranger District going back to 1880s; the Camp Robin project area had significant large fires in 1889, 1926, 1929, and 1945 (Figure 1). The fires in 1889 and 1926 in the project area had significant acreage burn outside the project area. The largest fire in the project area was in 1926. Table 1 summarizes recorded large fires and area burned in the Camp Robin project area.

Although landscape-scale stand-replacing fires have occurred in this area, all of the more “recent” fires occurring since the time of more advanced fire suppression have resulted in few acres burned, with the largest burning a total of 140 acres in 1988. Figure 2 shows several small fires burned in and near the project area from 1946 to present. Fire suppression has been successful in this area from the 1940's to the present, approximately 80 years. It is likely that successful fire suppression has modified this area to some degree. Landscapes tend to become more homogeneous when fire is removed because succession eventually advances all stands to similar communities dominated by shade-tolerant species (Hessburg et al 2005). The larger-scale fire events that have occurred on this landscape were considerably more variable in size than any type of management that has occurred since.

Table 1. Large fires by year and acreage burned in the project area. Accurate district records began in 1940.

Year	Acreage Burned in Project Area*
1889	6,747*
1914	56*
1917	243*
1918	57*
1919	100
1920	705
1922	190
1924	16*
1925	295*
1926	13,722*
1929	251*
1931	65*
1945	6,707*
1988	111*

*Total acres burned within the project area. These fires burned beyond the boundary of Camp Robin and account for more total fire acreage.

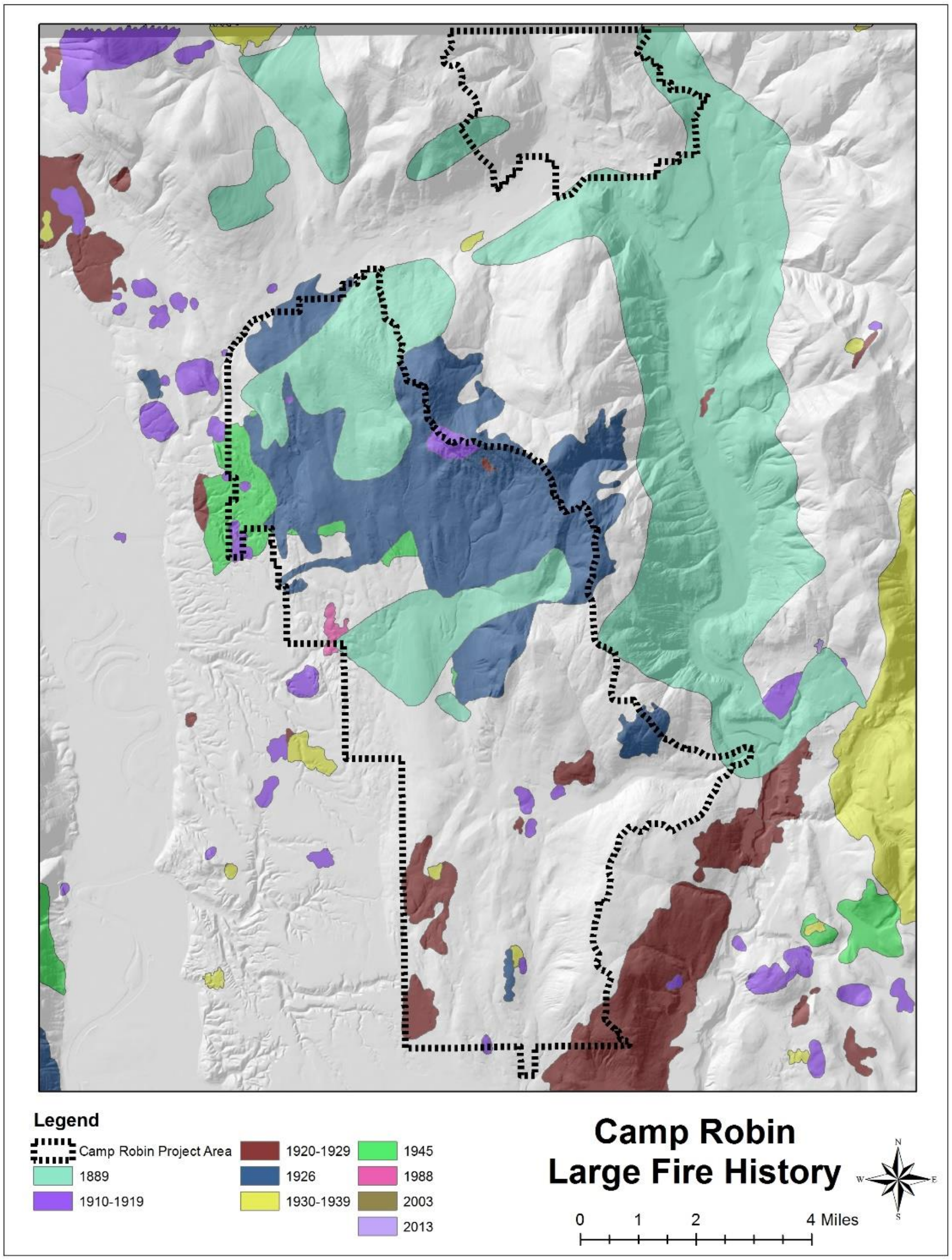

Figure 1. History of large fires in the Camp Robin project area and adjacent area. Some areas have burned multiple years.

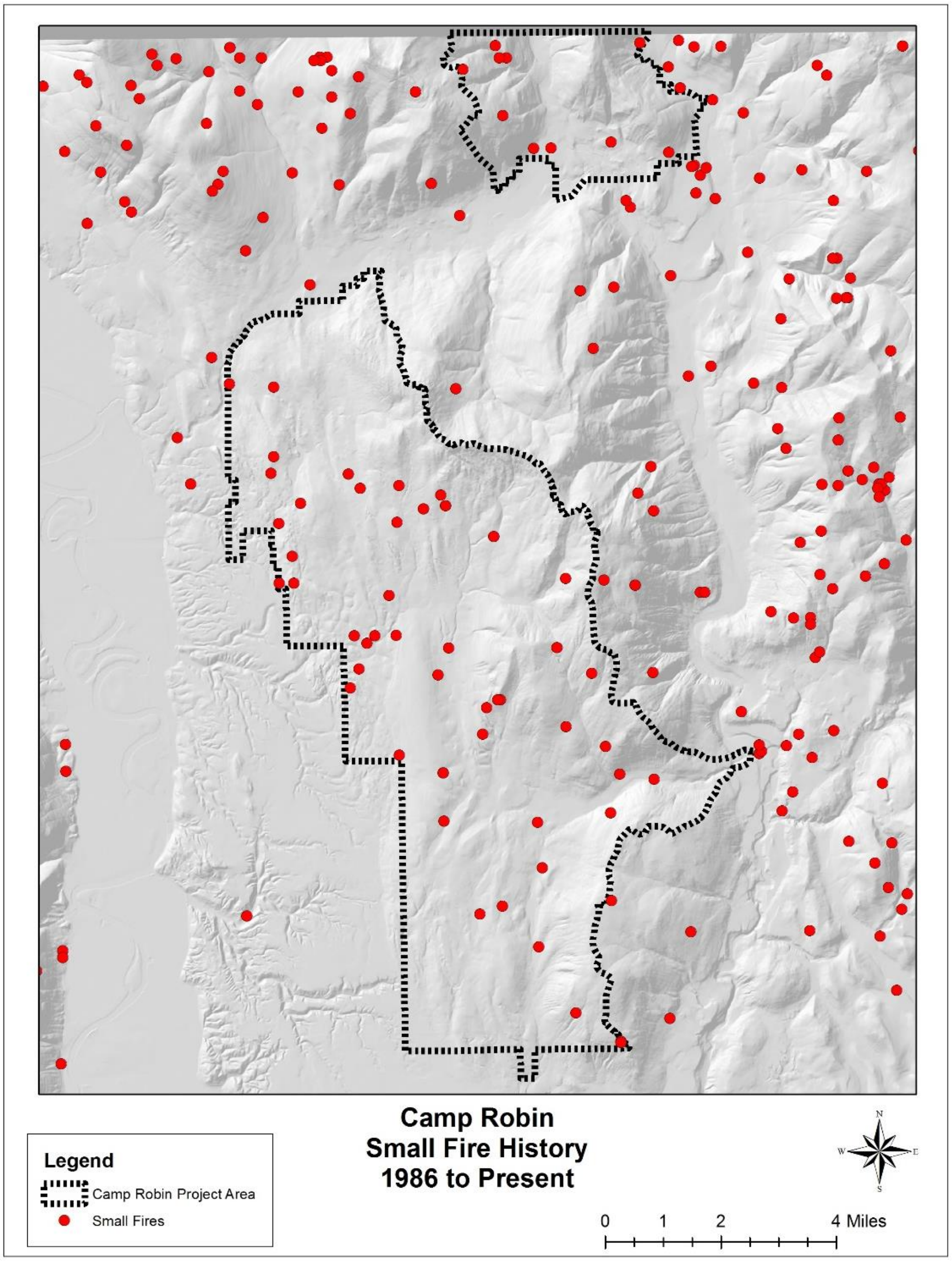

Figure 2. History of small fires (1986-Present) within the Camp Robin Project area and the adjacent area

Fuel Characteristics

Fuel Types

There are 13 fire behavior fuel models, developed by Rothermel (1972) and Albini (1976), and as described in Anderson (1982), which describe types of forest fuel conditions. These are used in fire behavior prediction modeling to estimate potential fire behavior based on their physical description of the fuel loading, fuel bed depth, and fuel moisture at which fire will not spread. These original 13 fire behavior fuel models are used to model fire behavior during the "severe period of the fire season when wildfires pose greater control problems and impact on land resources" (Anderson 1982). In addition to these 13, 40 dynamic fuel models were more recently developed (Scott and Burgan 2005) that are not limited for use to the severe part of the fire season. The addition of the 40 models increased the number of fuel models for forest litter and litter with grass or shrub understory. Predicted surface fire behavior drives crown fire models, so increased precision in surface fire intensity prediction will lead to increased precision in crown fire behavior prediction and hazard assessment (Scott and Burgan 2005). Since the new 40 provide more specific fuels characteristics, they were used to describe the surface fuels for this project.

The dominate fire behavior fuel models present in the Camp Robin project area are TU5 and GS2 (Figure 3). There are also units that have TL8 present. These fuel models were determined by data collection and analysis (Project File document 4). The fuel model TU5 is a very high load timber shrub model. The primary carrier of fire in this fuel model is heavy forest litter with a shrub or small tree understory. TU5 is characterized by moderate spread rates and moderate flame lengths. The fuel model GS2 is a moderate load, grass-shrub model. GS2 is characterized by high spread rates and the flame lengths are moderate. The primary carrier of fire in a GS2 is grass and shrubs combined. Fuel model TL8 is a long needle litter type. The primary carrier of fire in TL8 is long needle litter, and may include a small herbaceous load. Spread rate is moderate and flame lengths are low (Scott and Burgan 2005). These fuel models are used as inputs in fire behavior modeling for the fire and fuels analysis.

Figure 3. Example of fuel models GS2 in the project area (left) and TU5 (right)

The main fuel characteristics associated with these fuel models are moderate loads of timber litter with a noticeable continuity in the larger down-woody material (larger than 3 inches diameter), especially near root-disease pockets of trees. Shrubs and grasses are generally continuous and regenerating shade-tolerant trees are abundant, contributing to the ladder fuels (fuels that provide vertical continuity between layers of vegetation).

Fuel Loading

Fuel loading is made up of small woody fuels that are 3 inches and less in diameter and coarse woody debris, which is standing dead and down trees and branches larger than 3 inches in diameter. Small woody fuels include fine fuels such as twigs, small branches, live and dead brush and grasses, cones and needles. Coarse-woody debris is an important component of a healthy ecosystem. Animal life processes, site productivity and protection, as well as fire, are important components of coarse woody debris most commonly discussed by forest managers (Brown et al.

2003). Observations of past fire behavior shows that small woody material, less than 3 inches in diameter, has the most substantial influence on fire behavior (such as spread rates and fire intensity) and can be estimated using broadly accepted fire behavior models (Brown et al. 2003). However, large woody fuels can contribute to large fire development and high fire severity. The greater the fuel loading of this large material (and dependent on the size and decay rate), the greater the influence on fire severity. This effect is generally due to smoldering and persistent burn periods (Brown et al. 2003).

The coarse woody debris fuel loading for the project area ranges from 5 tons per acre to 43 tons per acre. This data was collected from the project area and is available in the project file which has the fuel loading values for material less than 3 inches in diameter and greater than 3 inches in diameter (Project File document 20). Recommendations by Graham et al. (1994) are 6.6-13.2 tons/acre for drier sites, such as those dominated by ponderosa pine and Douglas-fir, and 16.5-33.0 tons/acre for wetter sites where grand fir, cedar, and hemlock are climax species. These recommendations are for desirable biological benefits, but there must be a balance as to not create an unacceptable fire hazard (Brown et al. 2003). Many of the units have areas where there are pockets of high levels of coarse woody debris. From a fire behavior perspective, coarse woody debris should be reduced to levels within, but at the lower end of the recommended ranges. This is particularly important where it occurs in jackpots, as crowning out, spotting, and torching are more likely where heavy coarse woody debris has built-up in a forested environment (Brown et al. 2003).

Canopy Base Height

Canopy base height is the lowest height above the ground where there is a sufficient amount of canopy fuel to transition a fire from the surface fuels on the ground into the tree crowns (Scott and Reinhardt 2001). Therefore, canopy base heights are a critical factor in determining crown fire potential. Treatments to reduce fire hazard should focus on removing some or all of the ladder fuels and other vegetation that contributes to a low canopy base height, especially where reducing crown fire initiation is a priority (Agee and Skinner 2005). Canopy base heights were determined through Landfire data and verified across the project area from on-site observations (Project File document 1). Average canopy base height for the landscape was less than 7 feet.

Canopy Bulk Density

Canopy bulk density is the mass of available fuel per unit of canopy volume (kg/m^3). It is a bulk property of a stand, not an individual tree (Scott and Reinhardt 2001). Canopy bulk density is an important crown characteristic needed to predict crown fire spread, but it is a difficult characteristic to measure in the field (Keane et al 2005). However, there are good estimates available and they were used for this project. Canopy bulk densities were estimated from a combination of LANDFIRE national data as well as comparing site-observations to available research such as Scott and Reinhardt (2005).

Scott and Reinhardt (2001) describe the criteria necessary for active crown fire: Mass-flow rate is defined by Van Wagner (1977) as the rate of fuel consumption through a vertical plane within the fuel bed and it is a product of canopy bulk density and spread rate. Canopy bulk density affects the critical spread rate needed to sustain active crown fire. If the mass-flow rate falls below a certain threshold, active crowning is not possible. Therefore, the lower the canopy bulk density, the lower the potential for active crown fire. The current canopy bulk density in the Camp Robin project area ranges from 0.06 to 0.22 kg/m^3, and active crown fire is more likely at lower critical spread rates with canopy bulk density levels above 0.05 kg/m^3 (Scott and Reinhardt 2001).

Fuel Continuity and Treatment Size

In addition to considering the condition of forest fuels at the scale of the individual stand, it is also important to evaluate those conditions across the landscape. It is at the larger landscape scale that treatments have more potential for disrupting large fire growth and reducing fire movement. In recent years, it has been recognized that the spatial arrangement, size and amount of landscape treated can be important factors in how fast and intense a large fire can burn through a forest (Finney 2001, Finney et al 2007, Finney et al 2005, Weatherspoon and Skinner 1996). In a study of actual wildfire behavior, Finney et al (2005) noted that fire severity decreased more in larger treatment units as compared to smaller ones, and decreased more as one went from untreated areas further into areas that had been treated. Small and scattered fuels treatments are less effective at fragmenting fuel loads across a landscape and may be overwhelmed by intense fires burning in adjacent areas (Agee and Skinner 2005). In addition, researchers have found that larger treatment units could be more effective than smaller ones because fires burning up to larger treatments would be less likely to spot across the treatment area into untreated fuels (Weatherspoon and Skinner 1996, Van Wagtendonk 1996). Lastly, larger treatments could better serve as fuel breaks where suppression resources could engage the fire more safely and under more severe conditions. In a review of the scientific knowledge related to how modifying forest structure can change fire behavior and how fuel treatments can influence the behavior of large fires at the landscape scale, Graham et al. (2004) concluded that treating small or isolated stands without addressing the broader landscape will most likely be ineffective in reducing wildfire extent and severity.

Summary

All of the above fuel characteristics (fuel type, fuel loading, canopy base height, canopy bulk density and fuel continuity) interact to affect fire behavior. Desired fuel characteristics for this project are those that contribute to surface fire behavior rather than torching and active crown fire behavior. Less intense, desired surface fire behavior generally occurs when surface fuels are light, there are minimal ladder fuels, and overstory crowns are spaced to minimize fire spread from tree to tree. For this to occur, fuel loadings would typically be lower, canopy base height higher (ladder fuels), and canopy bulk density lower, and the result would be a different fuel type.

The overall goals for fire and fuels management are reduced fuels for the protection of public and firefighter safety. These goals are attained by creating forest conditions which result in slow rates of fire spread, low flame lengths (4 feet and below or the point at which ground crews can safely and directly attack a fire), and a low risk of crown fire. According to the forest plan, a desired condition is a sustainable forest system. In terms of fire management, this means fire-tolerant and resilient stands where wildfires burn in the surface fuels with low flame lengths such that life and property can be protected.

Environmental Consequences

Two alternatives were analyzed in detail to determine their effects on fire and fuels with regards to potential fire behavior (flame length, rate of spread, and crown fire activity).

The no-action alternative (alternative 1) is the same as the current condition. The proposed action (alternative 2) would involve the modification of fuels and vegetation on 6,577 acres. The effects of each of these alternatives were analyzed based on average and extreme fire conditions.

Effects Common to All Alternatives

Fuel Accumulation

Fuels would continue to accumulate in the project area with the continued growth and death of vegetation in areas that are not treated. The no-action alternative would not address current fuel conditions and would not address fire behavior as fuels would continue to accumulate and increase the risk of extreme fire behavior. The proposed action would address fuel accumulation in the project area. Treatment would reduce fuels and associated fire behavior characteristics such as flame length and rate of spread. In all stands treatment would need to be maintained with future entries to address the issue of decline in fuel treatment effectiveness over time (Agee 2002).

Wildfire Ignition

Wildfires would continue to occur in the project area regardless of which alternative is chosen. There is a risk of ignition from human-caused sources such as debris burning and abandoned campfires. This risk of human starts would remain, as the area is intermixed with private property and residences. Lightning is another source of ignition in the project area, and is a common occurrence in the Idaho Panhandle. Lightning is the cause of nearly 72 percent of fires on the Bonners Ferry Ranger District, whereas human-caused fires account for 28 percent of fires. Based on the percentage of lightning fires in the area, it can be expected that lightning would remain as the greatest risk of ignition in the Camp Robin area.

Probability of ignition is strongly related to fine fuel moisture, air temperature, shading of surface fuels, and an ignition source (Graham et al. 2004). In a stand that is opened up to the elements (such as through harvest), the chance for a fire start from an ignition source may increase due to increased surface temperatures and lower humidity; there is generally a warmer and dryer microclimate in more open stands (Graham et al. 2004, Agee and Skinner 2005). Under the proposed action there would be a short term increase of fuel associated with timber harvest activities. This increase would be between the time harvest activities occur and before fuel treatments are accomplished. The short term increase in fuel and open stand conditions, does create a condition for an increase in the risk of fire ignition. Although, treatment of fuels create conditions that allow firefighters to engage fires in ways that may not have otherwise been available due to a decrease in fire behavior (Graham et al 2009).

Dense stands generally have higher surface fuel moistures because there is more shading of surface fuels, higher relative humidity, and warmer air temperature (Graham et al 2004). The chance for ignitions would be high under hot and dry conditions, but where shaded, the probability of ignition may be lower when the weather is moderate (late spring and early summer). These shaded stands will still burn, and when they do they will burn with more intensity because of more abundant fuels than in more open stands. The proposed action would aim to mimic the effects of surface fuels and open structure of a forest maintained by fire. Even with a slightly elevated chance of a fire start in treated areas under the proposed action, fire spread would be expected to decrease. In the case of an ignition and resulting wildfire, spotting that accompanies crown fire would be reduced because of modified surface, ladder, and canopy fuels.

The orientation of the project area to the general wind direction may aid in fire spread to the northeast. Strong winds are generally associated with cold fronts, which can have an effect on fire behavior due to shifts in wind direction and downdrafts. More open stands created with fuels reduction and other types of vegetation treatments would generally have greater surface winds than adjacent dense stands (Agee and Skinner 2005), affecting fire intensities based on that factor alone. However, the effect of the increased wind on fire behavior is generally offset by the reduction in the fuel load.

Regardless of the actions taken within the Camp Robin project area, wildfires would still occur. No matter the management actions implemented, there is no intent to fire proof the forests. The reasons fires are suppressed are the same reasons management activities to modify vegetation are being proposed. Large-scale uncharacteristic and potentially severe fires are undesirable and a pro-active measure to mitigate possible negative effects, and safety concerns to the public and firefighters, makes sense across this particular landscape (wildland urban-interface).

Treatment and Canopy Opening Sizes

There are areas within the Camp Robin project area that have continuous forest fuels that are in a hazardous conditions (i.e., heavy loading, low canopy base height and/or high canopy bulk density). In order to effectively reduce the hazardous fuel conditions in some of those areas and produce stand conditions that are resilient and resistant to disturbances, it is necessary to regenerate the current stands and produce openings. As discussed in more detail in the forest vegetation report, if openings are created in excess of 40 acres in size, it is necessary to obtain permission from the Regional Forester.

The proposed action would create some openings that are larger than 40 acres in size. One reason that these larger openings is desirable is to effectively treat the forest fuels and create relatively large areas with fuels that are less prone to extreme fire behavior. Openings in a landscape create a more heterogeneous pattern, which assists in breaking up fuel continuity. Fire behavior and severity depend on fuel properties like fuel continuity (Graham et al. 2004). Large openings create areas where fire is disrupted by breaking up fuel continuity. The larger the openings the more effective treatment areas are for suppression resources to engage the fire more safely and under more severe conditions. Smaller openings do not create the same areas that reduce potential wildfire activity. Smaller areas are subject to increased risk of spotting as there is less distance for embers to travel to reach receptive fuels (Weatherspoon and Skinner 1996, Van Wagtendonk 1996). The proposed action includes large openings that meet the purpose and need to promote forest conditions that reduce the risk of wildfire to National Forest System lands. Smaller openings do not provide the same opportunities for successful fire suppression; further, with the no-action alternative no new openings would be created for firefighters to take safe and effective suppression action from.

Direct Effects and Indirect Effects

Fuels Characteristics

Fuel characteristics for each alternative are briefly described in terms of fuel model change and associated characteristics associated with each (fuel loading, canopy base height, and canopy bulk density). Modification of the fuels following treatment would affect the indicators (flame length, rate of spread, and crown fire activity) due to removal of fuels through harvest and prescribed fire. The following tables summarize the modifications of fuel characteristics by alternative.

Table 2. Fuel characteristics by alternative, the proposed action assumes treatments have been completed

Alternative	Canopy Base Height (feet)	Canopy Bulk Density (kg/m3)
1 (existing conditions)	1-7	0.06 - 0.22
2 (proposed action)	20+	0.01 - 0.10

Alternative 1

Alternative 1 would result in no actions to reduce surface fuel loading, increase canopy base height, or reduce crown bulk density. The canopy base height would remain at levels of 7 feet and less and canopy bulk density would remain at higher levels than alternative 2 (Table 2). As a result, this alternative would not lessen the potential for extreme fire behavior in the project area.

The dominant fuel models present in the project area are TU5 (165) and GS2 (122) as summarized in Table 3. With the no-action alternative, the fuel models would remain the same and with vegetative growth and death, the trend would be toward fuel models with a heavier fuel loading such as TU5.

Alternatives 2 (Proposed Action)

Alternative 2 includes actions designed to reduce surface fuel loadings, increase canopy base height, and decrease crown bulk density. The changes in fuel characteristics are summarized in Table 2, which shows there would be an effect on the project area with each of these alternatives. The canopy base height would increase substantially on treated areas to 20 feet and higher. The canopy bulk density decreases on treated acres for the proposed action to lower levels than the no-action alternative.

Figure 4. Example of fuel models TL3 (left) and GR1 in foreground (right)

In the proposed action, the fuel models in the units would change to a lighter fuel loading. Fuel models TL3 and GR1 (Figure 4 and Table 3) are lighter fuel loading that the project area would be represented by after treatments. Fire behavior fuel model TL3 (183) is a moderate load conifer litter with a light load of coarse fuels. Expected spread rate and flame length are low for this fuel model. Fuel model GR1 or 101 is a short, sparse grass that has lower spread rates and flame lengths compared to other grass fuel models (Scott and Burgan 2005). When comparing these expected fuel models with the representative fuel models for the existing condition, the current fuel models have higher expected rates of spread and flame lengths.

Table 3. Fire behavior fuel models by treatment type, showing pretreatment and post treatment

Treatment Type	Fuel Model: Before Treatment	Fuel Model: After Treatment
Regeneration Harvest Rx's	TU5, GS2	TL3
Intermediate Harvest Rx's	TU5, GS2, TL8	GR1, TL3
Prescribed Burn Only	TU5, GS2, TL8	GR1, TL3

Fire Behavior

Flame Length

The BehavePlus 6.0.0 program was used to model flame length for each alternative. Figure 5 displays the results of the flame length analysis for different vegetation treatments. Without treatment in these stands, the shade-tolerant understory vegetation would continue to grow and replace the overstory. As the current overstory dies and falls down, it would cause an accumulation of surface fuels and potential flame lengths would be greater than 4 feet (Project File document 10). Past projects similar to the Camp Robin project show that flame lengths in treatment areas stay below the 4 foot threshold for several years into the future with similar treatments to what is proposed (Hellroaring and Deer Creek – Project File). The Camp Robin area would be expected to have similar long-term efficacy of treatments, especially in areas that follow harvest treatment with prescribed fire.

Effects of Alternative 1 on Flame Length

The existing condition (fuel models TU5 and GS2) shows that with environmental conditions at or above the 97th weather percentile, flame lengths surpass the 4-foot threshold (red line on Figure 5) at which crews can directly attack a fire. Areas in the project area represented by TU5 surpass the 4-foot threshold for all wind scenarios modeled, and areas of GS2 surpass the 4-foot threshold for all but the lower wind speeds. There would also be no reduction in the flame lengths near values (e.g. Forest Service developments, homes, private property, and infrastructure). The number of acres with flame lengths greater than 4 feet would most likely increase over time. This means more acres could burn with higher intensities near those values as stands continue to accumulate fuel over time.

The no-action alternative would allow the stands to continue in succession until some disturbance process takes place; if fire continues to be successfully excluded, forest insects and disease would assume the primary disturbance process of the stands. The accumulation of biomass on the forest floor would contribute to higher flame lengths and subsequently greater fire intensities in the event of a wildfire. Figure 5 shows, the flame lengths surpass the 4-foot threshold that allows firefighting crews to directly attack a wildfire.

Effects of Alternative 2 on Flame Length

Flame lengths after treatment are displayed in Figure 5. Flame lengths would be reduced in all treatment types (TL3 and GR1), and these effects would be expected to last for several years into

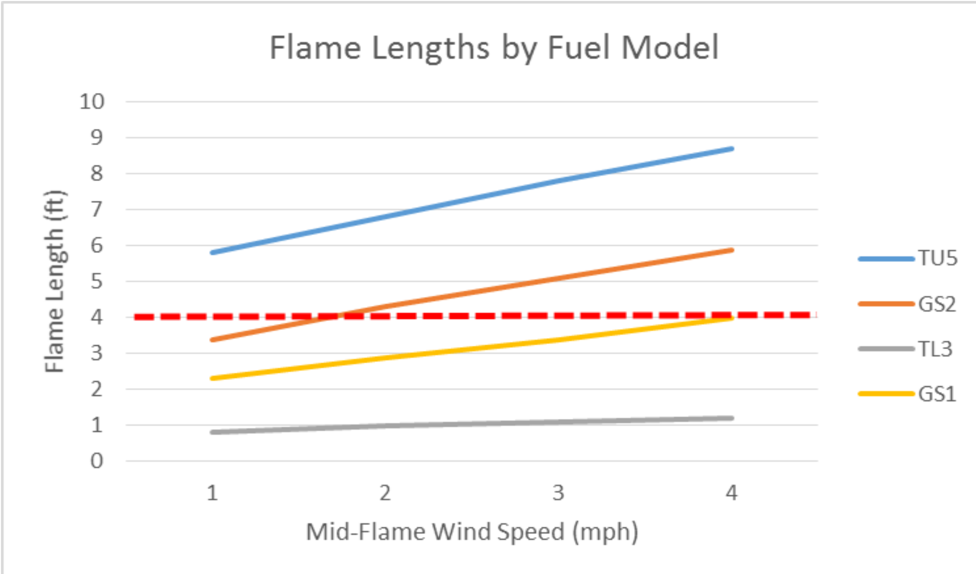

Figure 5. Predicted flame length by current representative fuel model and expected fuel model (post-treatment). The red, dashed line is added to highlight the 4 foot threshold where it is safe for grounds crews to directly attack a fire.

the future. At a certain point, flame lengths would increase as fuels accumulate and vegetation grows.

Rate of Spread

Rate of spread of a surface fire is a basic measure used by initial attack firefighters and fire resource planners to predict the effectiveness of fire suppression strategies and tactics. For this analysis, a spread rate threshold of 5 chains (330 feet) per hour was used to display the effects of each alternative on spread rate across the landscape. Fires that are moving less than 5 chains per hour would have a higher likelihood of being contained than fires with a higher rate of spread. This is based on firefighting resource capability and availability. Fires that are moving faster than 5 chains an hour were predicted in BehavePlus to escape initial attack after 1 hour (Project File document 13).

Additionally, to analyze rate of spread, the minimum travel time function was used in the FlamMap fire behavior program. The minimum travel time feature is a two-dimensional fire growth model. It calculates fire growth and behavior by searching for the set of pathways with minimum fire spread times from ignition sources. The use of minimum travel time allows for a comparison of expected fire arrival time to given points using the treatments associated with each alternative. Arrival times show when a theoretical fire reaches areas across the landscape, and is an indicator of how long firefighting resources have to take action. The effect of a fire traveling across the landscape and the disruption of fire movement is best analyzed using minimum travel time. Figure 6 and Figure 7 provide a visual display of when a fire may be expected to reach identified values across a landscape with no-action and the proposed action.

Effects of Alternative 1 on Rate of Spread

Under severe conditions, the rate of spread with the no-action alternative has the potential to move at a rapid rate. Using the rate of spread threshold of 5 chains per hour shows that 54 percent of the project area is predicted to have slower moving wildfires that initial attack crews would be able to suppress within the first few hours after discovery under severe conditions (Table 4). As forest successional processes continue and more of the area becomes susceptible to faster moving fires, the area expected to have slower moving fires would decrease as well. This places more values at risk since there would be a higher likelihood that a fire would escape initial attack and threaten those values.

In the case of a simulated fire, the no-action alternative would have arrival times that are faster than the proposed action (Figure 6). Figure 6 shows the expected arrival times under the no-action alternative. With no action there would be no reduction in the rate of spread on National Forest System lands near the identified areas of concern, which includes several types of values such as travel routes, Forest Service developments, private property, and homes. Over time, the accumulation of fuels due to forest succession and the potential increase in crown fire activity would lead to faster moving fires, thus placing more of the values at risk to fire in a shorter time period.

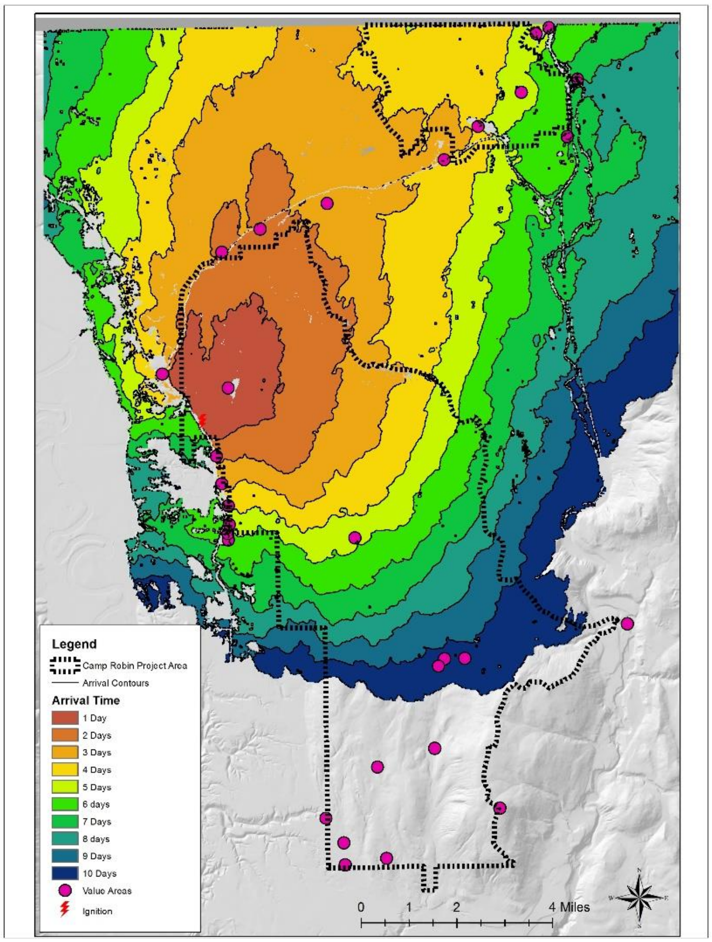

Figure 6. Estimated arrival times for no-action alternative. The pink dots represent areas of concern (values) as a reference. This assumes a free burning fire with no suppression actions.

Effects of Alternative 2 on Rate of Spread

Rate of spread on the landscape is predicted to decrease with the implementation of the proposed action (Table 4). Alternative 2 would have 59% of the project area that has rates of spread below the 5 chains per hour threshold.

Table 4. Acres of potential rate of spread over or under 5 chains/hour burning under severe conditions within the Camp Robin Project Area by alternative

Alternative	Rate of Spread less than 5 chains/hour	Rate of Spread greater than 5 chains/hour
1	22,850 acres (54%)	19,429 acres (46%)
2	25,089 acres (59%)	17,190 acres (41%)

Rate of spread percentages are based on the total Camp Robin project area which is 42,279 acres.

Also, the modeled minimum travel time would increase (Figure 7) with the implementation of alternative 2. The proposed units in alternative 2, disrupt fire movement across the landscape and increases the minimum travel time. An increase in the time at which a fire can be expected to reach a given location allows firefighters more options in fighting a wildfire. This could include the arrival of additional resources and the ability to use more fire suppression tactics. It is important to note that the travel times shown in Figure 6 and Figure 7 represent expected travel times from a fire at a given location. If a fire were to start at a different point on the landscape, travel times could be different. Treatment areas are expected to impede fire movement, which is where alternative 2 would differ from no-action alternative.

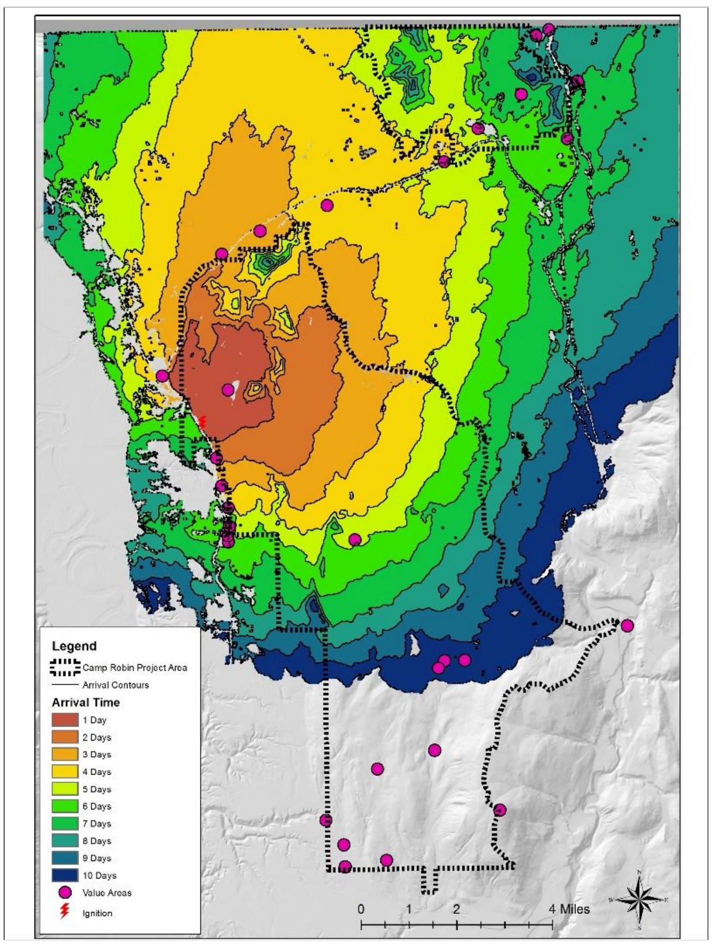

Figure 7. Estimated arrival times for the proposed action. Pink dots are areas of concern (values). This assumes a free burning fire with no suppression actions.

Crown Fire Activity

Reducing the risk of crown fire in the wildland-urban interface is a necessity to reduce risk of unwanted fire effects such as loss of human values (Graham 2004). Reducing the risk of crown fire requires that canopy bulk density be reduced, canopy base height be increased, and surface fuels be reduced to decrease spread rate and intensity (Scott and Reinhardt 2001).

Crown fire activity represents a problem for fire managers (Rothermel 1983) and the public due to the high rates of spread and very high intensity. Crown fires are a major risk to values such as life and property and limit firefighting capabilities and tactics due to firefighter safety. If a fire were to transition to a crown fire, flame lengths and rate of spread would be beyond the ability of firefighters to directly attack the fire (Project File document 5). Direct attack requires flame lengths of less than 4 feet and a rate of spread at less than 5 chains per hour. In addition, spotting and increased radiation make structures more difficult to defend from crown fire than a surface fire (Cohen and Butler 1998 and Scott and Reinhardt 2001).

FlamMap was used to evaluate crown fire activity across the project area and to determine the amount of acreage that could see potential crown fire under severe fuel conditions and strong winds. **Error! Reference source not found.** summarizes the results of the FlamMap output for each alternative.

Table 5. Acres of potential crown fire activity under severe conditions within the Camp Robin project area. The percentages are based on the total Camp Robin project area which is 42,279 acres.

Alternative	Acres of Surface Fire	Acres of Crown Fire
No Action	12,279 acres (30%)	29,511 acres (70%)
Proposed Action	17,334 acres (41%)	24,945 acres (59%)

Effects of Alternative 1 on Crown Fire Activity

With no action, fuel buildup over time in the Camp Robin project area would most likely lead to an increased probability of a large, uncontrollable wildfire due to increased fire intensity associated with higher fuel loads, which would hamper fire suppression efforts. Table 4 shows that approximately 70% of the project area has potential for crown fire activity under severe conditions.

Effects of Alternative 2 Crown Fire Activity

With alternative 2 (proposed action) removal of fuels would help reduce the probability of a large, uncontrollable wildfire due to a decrease in fire intensity associated with lower fuel loads. Along with changes in surface fuels, crown fuels would be reduced through the removal of overstory.

Table 5 shows the potential for crown fire across the landscape is reduced with alternative 2 to 59% of the project area. This is due to the vegetation treatments creating higher, less dense crowns on the landscape

Effects of Precommercial Thinning on Fire Hazard

Alternative 2 proposes 89 acres of precommercial thinning. Following thinning, and without slash treatment, surface fuels would be most similar to a light slash fuel model 11. Fires can be active in the slash and intermixed herbaceous material exhibiting higher rates of spread and flame lengths of approximately 5 feet – greater than the 4-foot threshold for direct attack suppression. Canopy base heights of the residual trees would be very low (less than 2 feet), so torching would be expected. However, tree density would be reduced by as much as 90 percent, limiting fire movement through the canopies of the remaining young trees.

Treatment to disrupt fuel continuity and minimize slash heights would moderate the fire hazard described previously (in those stands that would not be grapple-piled and burned) even within the first couple years. These treatments include directional felling to minimize activity fuel outside units, lopping and scattering the material to disrupt continuity, and laying it horizontal to the ground promoting compaction, especially under winter snow loads (compacted fuels have greater fuel moistures and they decay more rapidly). With the slash treatment, after fine fuels such as needles have fallen, fire behavior would moderate even further. Flame lengths would drop to between 2 and 3 feet, which is within the range of direct attack. In precommercial thin units adjacent to private land, design criteria requires piling and burning to minimize short-term fire risk.

Even without the proposed treatment of the thinned material, empirical data from previously thinned stands across the north zone of the Idaho Panhandle National Forest indicate fire hazard from thinning slash is naturally mitigated after approximately 5 to 7 years following thinning. Fine fuels have long fallen, stems and branch wood have become incorporated into the ground, and decomposition of much of this material has occurred. Following treatment and natural mitigation, surface fire behavior would be decreased as compared to the units before thinning; after 5 to 7 years, surface flame lengths would be consistent with the desired condition of fuel model 8 (less than 2 feet). However, by treating the precommercial thin units, there would be an additional fire hazard reduction above the current condition because trees would be spaced farther apart (reduced canopy bulk density over time) and as the remaining trees grow the canopy base heights increase. Potential spread rates and fire intensity would be further mitigated with design criteria that stagger the implementation of the precommercial thin units.

Effects of Aspen Treatments

The Camp Robin area has a significant hardwood component present in several stands proposed for treatment. The main species of hardwood in these areas is aspen. Aspen provides key ecological values including species diversity and wildlife use of aspen stands. In addition to these values, aspen stands are generally not highly flammable, so fires typically burn with low rates of spread and low intensities (Stevens-Rumann et al. 2017). Areas identified for treatment have a relatively high presence of aspen. These aspen areas are experiencing encroachment by conifers causing competition for sunlight, water and other nutrients. In these areas mature aspen appear healthy, but regeneration is not vigorous. Removal of competing vegetation using prescribed fire is proposed. As mentioned above, aspen stands are not highly flammable and are desirable to have in a project area that is in wildland-urban interface. Expansion and retention of these aspen areas are important to creating more fire resilient stands.

Summary of Effects

The effects of the proposed action would produce a reduction in fuels, which would result in a reduction in flame lengths, rate of spread and the potential for crown fire activity. Table 6 summarizes the effects each of the alternatives has on these indicators.

Table 6. Fire behavior indicators for no action and proposed action alternatives, this is within proposed units.

Alternative	Surface Flame Length (ft.)	Rate of Spread (chains/hour)	Crown Fire Activity*
No Action Alternative	4 - 9	5+	2, 3
Proposed Action (Alt. 2)	0 - 4	0 - 5	1

*Crown Fire Activity Codes: 1=Surface, 2=Passive, 3=Active

Effects to Air Quality

Prescribed burning of forest fuels affects air quality through the production of smoke, which contains particulate matter that can be a human health hazard. The Idaho Panhandle National Forests is a member of the Montana/Idaho Airshed Group, which is composed of members who conduct a "major" amount of prescribed burning and the regulatory and health agencies that regulate this burning. The intent of the Airshed Group is to minimize or prevent smoke impacts while using fire to accomplish land management objectives and/or fuel hazard reduction.

The monitoring unit of the Montana/Idaho Airshed Group coordinates burning and smoke emissions to minimize smoke accumulation and provides smoke dispersion forecasts and air quality monitoring support for burners in the Airshed Group. The monitoring unit considers proposed burns together with expected ventilation or smoke dispersion conditions and existing air quality to determine burn recommendations for the following day (with concurrence from the Idaho Department of Environmental Quality). These procedures limit smoke accumulations to legal, acceptable limits. The District strictly complies with procedures required by the Airshed Group, and has had no air quality violations. Proven protocols are already in place that assures compliance with all legal and regulatory requirements regarding air quality. For more information on Air Quality and policies and procedures refer to project file document 14.

Cumulative Effects

Past, Present, and Foreseeable Activities Relevant to Cumulative Effects Analysis

In the Camp Robin project area, past activities that contribute to cumulative effects are fire suppression, precommercial timber stand improvement, timber harvest on all ownerships, and prescribed burning. For this analysis, harvest includes related activities such as road building and tree planting. Public activities (such as huckleberry picking, hunting, and firewood gathering) are not expected to have cumulative effects; a potential rise in human-caused fires due to increased use following harvest is not likely to occur (based on other vegetation management activities across the district). Reasonably foreseeable activities include National Forest and private timber harvest. There are no other reasonably foreseeable activities that would reduce the fire and fuels resource.

Timber Management

The North Zone Roadside Salvage Project will involve removal of trees from the along roadsides across the Bonners Ferry District. This removal of trees will result in some fuel reduction along open roads, which are prone to fire starts. This would help slow fire spread into adjacent woodlands if a fire were to start along the road. Additionally, ingress and egress routes will be improved to allow firefighters and the public to travel safely into and out of the area.

There are several current timber sales in and around the Camp Robin project area, which are all in various stages of implementation. There are sales associated with the Hellroaring analysis and the Deer Creek analysis. These two projects include harvest and prescribed burning. These projects were designed to reduce potential wildfire behavior, which includes flame lengths, rate of spread and crown fire potential. Fuels reduction activities associated with these projects would contribute to landscape level fuels modifications that are reducing potential fire behavior in the area of Camp Robin.

Private timber harvests would still occur around the project area. Commercial harvest on private lands would decrease crown fire potential and, if the surface fuels are treated sufficiently to reduce fire intensity, overall fire behavior would be lowered. Those areas where surface fuels are not disposed of would result in more intense surface fire.

Extensive vegetation management activities on National Forest System lands within the project area have occurred, and can be referenced in the Camp Robin vegetation report (Helgenberg 2018). These activities included commercial timber harvest and precommercial thinning. Previous and future harvest activities by the Forest Service have and will reduce fuel in the project area. The fuel modification has effects on how fire will burn through an area. As fire moves from stand to stand, fire intensity and crown fire potential either increase or decrease depending on stand characteristics. If a crown fire moves into a stand not having crown structures that can support crown fire, the fire would be forced to drop to the surface fuels (such as in recent past thinnings). Regeneration harvests that are two or more decades removed from the time of entry have fuel structures (advancing regeneration) that in time would contribute to crown fire potential if left without further management (Agee and Skinner 2005).

Additional vegetation treatments would be necessary to mitigate hazardous fuels and crown fire potential into the future just as a portion of the Camp Robin project proposal involves treatments on stands that were previously treated. Forest succession adds to the fuel structure of stands as trees grow and die and decay. Without a means for fuels reduction (natural or prescribed), the normal cycles of forest growth and development would ensure the accumulation of fuels into the future. These activities can include precommercial thinning, biomass utilization, piling and burning, and prescribed fire, along with many other activities not proposed for this project but could be considered in the future (mastication, chipping, etc.). The silvicultural prescriptions that include a schedule of future entries benefit fuels reduction into the future.

Wildfire and Fire Suppression

Wildfires will continue to ignite into the future within and near the project area. Thunderstorms can be expected to occur across the Bonners Ferry Ranger District. Over 70 percent of documented ignitions since the 1940s within the project area are lightning caused. As development and human use of the area continues, risk for ignition will exist. Treatments may be effective at reducing fire behavior and severity, but not necessarily a reduction in occurrence (Reinhardt et al. 2008). Fire suppression will continue because the area is within the wildland-urban interface, and is a continuation of current management. This management strategy means that the effects of 80 years of suppression would continue on their current trend.

The no-action alternative would allow the continuation of surface fuel accumulation, as well as the changes in fire behavior associated with a change in forest structure and species. With the proposed action, fuels would be reduced in the proposed units, but areas outside of the units would continue to have fuel accumulation. Where larger open pockets are created, fire personnel have more available opportunities to manage future fires safely, more effectively and efficiently with a higher probability of success in the timber fuel models. A proactive approach to this increases the probabilities of success, especially with the wildland-urban interface increasing trend. Outside of treatment areas, subsequent management would be necessary, as mentioned earlier, to reduce fuels and mitigate fire behavior.

When fire is excluded, the fuels that do not burn remain on the landscape and will likely increase through additional vegetation growth stages if other reduction factors (e.g., disease, insects, prescribed fire, mechanical treatments) do not intervene. When fire finally does occur, the potential for the rapid growth of large, difficult to control wildfires is increased (Graham et al. 2004). Successful fire suppression without prescribed fire causes an increase in amount and continuity of the living and the dead material that fuels fires (Saveland 1998). The continued loss of fire-resistant species would continue to lead to forests that are less resilient to fire, meaning that they could experience more pronounced fire effects and an increased amount of trees killed by wildfire. A noticeable cumulative effect on fuels and fire behavior in the stands and on landscapes are the dead and dying trees falling and contributing to heavy surface fuels. The effects of no action on wildfire behavior have been described throughout this document.

In the cumulative sense, modeling suggests a continued inaction to lessen fire hazard means an increasing potential for high fire intensities and severities until at some point in time a large stand-replacing fire occurs, leaving the landscape in a post-replacement state. Fire exclusion has many effects that are documented in the publication *Cascading Effects of Fire Exclusion in Rocky Mountain Forests* (Keane et al. 2002). Many of these effects have been directly observed in the Camp Robin project area. Fire exclusion causes forest composition to change/shift from early seral, shade-intolerant tree species to late-seral, shade-tolerant species. This influx of shade tolerant understory species has altered stand structures as single-layer canopies have progressed towards multiple-layer canopies, as discussed in the Camp Robin vegetation report (Helgenberg 2018).

An important stand characteristic that changes with advancing succession in the absence of fire is the increase in the amount of dead and live biomass or fuels. Fuel loadings generally increase in the absence of fire because of a myriad of ecological factors. First, long fire-return intervals mean live fuels have longer times to grow and dead fuels have longer periods to accumulate on the ground. Next, crown fuels increase because late-seral, shade-tolerant species tend to have more biomass in the forest canopy due to their high leaf areas, and biomass tends to be well distributed over the height of the trees. Because late-seral species are shade-tolerant, there are many smaller seedlings and saplings present in the understory to take advantage of any gaps in the canopy. So, the greater crown biomass distributed along greater parts of the stem, coupled with high seedling and sapling densities, can create the ladder fuels that allow flames from surface fires to climb into the forest canopy and result in crown fires.

In fire-dependent ecosystems it is important to acknowledge that in the long run fire suppression, even if necessary for protection of life and property, may be undesirable due to aforementioned reasons (fuel accumulation, insects and disease, etc.). This makes fuel hazard reduction even more important. It is difficult to ensure the prevention of large fire occurrence and development. Reducing the potential severity when a large fire does occur may save ecosystem elements conditioned to historical fire (Reinhardt et al. 2008). Management activities are being designed to initiate an improvement trend, the hope being that when a wildfire does occur, the disturbance and effects on resources and ecosystem components would be more in sync in relation to a historic range and scale.

Private Burning

Open burning season is from October 21 to May 9 annually and many rural residents choose this time to burn ditch lines, brush, timber litter and other woody and herbaceous materials on their land. Outside of this timeframe, a permit is required from the Idaho Department of Lands. Though the actual burn activities on private lands would not overlap in time or space, impacts from the smoke produced from them may. As local air quality would continue to be affected by private land burning during the open season into the future, project-specific burning would be accomplished at the same time as the impacts from these other smoke sources.

Residential Development

The project area may have increases in development on private lands and subsequent increases in people using the project area. Therefore, the number of values at risk could increase over time. Programs such as Boundary County's FireSafe program or other defensible space programs would continue to benefit those landowners who implement them. Landowners that treat fuels within their home ignition zone as well as other areas would create safer conditions for more landowners. Those landowners who do not treat around their homes would be further at risk since most of the developments would be occurring within close proximity to National Forest System land, which are not scheduled to be treated. If the Forest Service treats land adjacent to private property, it would work in combination with fuels reduction on private land to reduce risks. If fuels are not reduced within the home ignition zone there would be a higher risk of home loss from fire due to untreated fuels near the structure (Cohen 2001). Although, by reducing potential fire behavior away from the values (with the proposed action) the likelihood of a fire spreading and reaching the value would be reduced.

The likely increases in the private land development may also increase potential ignition sources (from activities such as debris burning or road construction), which could place more values at risk. Treatments on National Forest System land can disrupt the fuel complex between potential ignition sources and values. This could reduce potential fire behavior.

Design Features

1. Timber harvest activities have the potential to create additional fuel on the forest floor. In order to mitigate the potential increase in fire hazard, one or more fuel treatment methods would be used in all harvest units. There are several methods that could be used to accomplish this:
    - Grapple-piling the fuel followed by pile burning;
    - Prescribed broadcast or underburning;
    - Biomass utilization or whole tree yarding (recommended in combination with one of the above);
    - Harvest timed to minimize the amount of slash left during fire season (July-September).

    Each of the proposed harvest units has a specific fuel treatment method prescribed for it. However, during project layout or implementation, if a change is proposed to a fuel treatment activity, a fuel specialist would be consulted in order to avoid increasing fire hazards.

2. Fireline would be constructed when necessary to contain prescribed burns.

Estimated Effectiveness: High. Harvest operations which include a method of utilizing or reducing activity created surface fuels are effective at accomplishing fuels reduction objectives (Graham et al. 1999). Overwintering will help compact fuels as snow and ice settles on them – compacted fuel will burn with a lower rate and intensity versus those which are not because of the supply of air and increased fuel moistures under the compacted material.

3. Where PCT is proposed, activity created fuels will only be mechanically treated (mastication or grapple-piled and burned) on select units due to site and resource constraints (slope and soils disturbance). Mechanical piling and burning would include units adjacent to private property to minimize short-term fire risk.

   For the PCT units that will not be piled or masticated, recommendations to treat the slash and minimize the fire hazard include the following:
   - Directional felling (into the interior of the unit) to minimize the amount of activity fuels along unit boundaries;
   - Lopping and scattering in high risk areas (e.g., adjacent to untreated fuels or along roads) and in all areas the cut material would be left as compacted as possible and horizontal to the ground (<18” fuel depth);
   - Staggered timing of PCT-only units:
     - If immediately adjacent to a proposed harvest unit, PCT-only will occur after post-harvest fuels reduction activities have occurred.
     - A staged approach for implementation is recommended to further mitigate fire hazard across the landscape. This will break up the continuity of slash fuels occurring on the landscape at any one time.

Estimated Effectiveness: Moderate-High. Empirical data from across the north zone of the Idaho Panhandle National Forests suggests slash fuels from PCT thinning activities are mitigated in generally 5-7 years, especially with the aforementioned treatments.

Compliance with Forest Plan and Other Relevant Laws, Regulations, Policies and Plans

The proposed action consistent with direction in the Forest Service Manual (FSM 5100). In particular: to use fire in a safe, carefully planned and cost-effective manner, to alter fuel profiles so that public and firefighter safety is improved and communities, infrastructure and other values are less impacted from wildfire, to reduce future suppression costs and unwanted effects, and to achieve desired conditions and attain management objectives in the forest plan. The proposed action is designed to help accomplish the goals of the 10-Year Comprehensive Strategy (Strategy) by reducing hazardous fuels and improving suppression. The no-action alternative does not address the other objectives of fire management (FSM 5140) or the goals of the Strategy.

The 2015 Forest Plan forest wide direction includes desired conditions, objectives and guidelines for fire and air quality. The desired conditions for fire and air quality include:

- Public and firefighter safety is always recognized as the first priority for all fire management activities.
- Hazardous fuels are reduced within the WUI and other areas where values are at risk. Fire behavior characteristics and fuel conditions exist in these areas that allow for safe and effective fire management. Fire behavior is characterized by low-intensity surface fires with limited crown fire potential. Forest conditions, and the pattern of conditions across

the landscape, exist in these areas such that the risk is low for epidemic levels of bark beetles, high levels of root disease, and large scale, stand replacement wildfires.
- The use of wildland fire (both planned and unplanned ignitions) increases in many areas across the Forest. Fire plays an increased role in helping to trend the vegetation towards the desired conditions while serving other important ecosystem functions. However, when necessary to protect life, property and key resources, many wildfires are still suppressed.
- The Forest meets applicable federal, state, or tribal air quality standards. Prescribed burning is planned to meet those standards, including areas classified as Class 1 airsheds (e.g., Cabinet Mountains Wilderness) and nonattainment areas.

The forest wide objectives for fire include:

- The outcome is the treatment of fuels on approximately 6,000 to 16,000 acres annually on NFS lands, primarily through planned ignitions, mechanical vegetation treatments (these acres are also included in FW-OBJ-VEG-01), and unplanned ignitions. NFS lands within the WUI are the highest priority for fuel treatment activities.
- Over the life of the Plan, manage natural, unplanned ignitions to meet resource objectives on at least 10 percent of the ignitions.

The forest wide guidelines for air quality include:

- The Forest should cooperate with the federal, state, tribal and local air quality agencies as appropriate in meeting applicable air quality requirements.

Forest plan management areas (MA) desired conditions:

- MA6 is that fuels are reduced, particularly within the wildland urban interface, to reduce the threat of wildland fire.

Forest plan Geographic Area desired condition:

- Threats of wildfire are reduced for the following specific areas: communities of Bonners Ferry, Moyie Springs, Naples, Eastport, Porthill, Copeland, and Moravia; the Kootenai Tribal community; outlying communities and structures, and Highway 2, Highway 95, and Highway 200 corridors.

Following is a description of how each alternative meets these forest-wide, Management Area, and Geographic Area desired conditions, objectives and guidelines.

Alternative 1 (No Action)

The no-action alternative would recognize firefighter and public safety as a priority in fire management activities, but would not take any preventative measures in reducing hazardous fuels in this WUI area. The alternative would not use planned fire ignitions to trend vegetation to desired conditions.

The no-action alternative would not meet the objectives to treat fuels through the use of fire or mechanical treatments. Management of unplanned ignitions would likely not be done in this area due to it being a WUI, and the management of unplanned ignitions would be left to other appropriate areas of the Forest.

In terms of meeting air quality guidelines, the Forest is a member of the Idaho/Montana Airshed Group. The District strictly complies with procedures required by the Airshed Group, and has had no air quality violations. Proven protocols are already in place that assures compliance with all legal and regulatory requirements regarding air quality. Under the no-action alternative no planned ignitions would take place. For more information on Air Quality and policies and procedures refer to the project file.

For MA 6, planned ignitions would not be implemented with the no-action alternative. Additionally fuels would not be reduced as part of the no-action alternative. Finally, fuels would not be reduced in areas such as Copeland, Eastport, or Moyie Springs and other outlying communities with the no-action alternative.

Alternative 2 (Proposed Action)

Alternative 2 would recognize firefighter and public safety as a priority in fire management activities, and would take action in reducing hazardous fuels in this WUI area. The alternatives would use planned fire ignitions to trend vegetation to desired conditions.

The alternatives would meet the objectives to treat fuels through the use of fire and mechanical treatments on 6,191 acres, which would work towards the goal of 6,000 to 16,000 acres annually. Management of unplanned ignitions would likely not be done in this area due to it being a WUI, and the management of unplanned ignitions would be left to other appropriate areas of the Forest.

In terms of meeting air quality guidelines, the Forest is a member of the Idaho/Montana Airshed Group. The District strictly complies with procedures required by the Airshed Group, and has had no air quality violations. Proven protocols are already in place that assures compliance with all legal and regulatory requirements regarding air quality. Under the proposed action planned ignitions would take place and guidelines would be followed.

For MA 6, planned ignitions would be implemented with the proposed action. Additionally, fuels would be reduced as part of the proposed action. Finally, fuels would be reduced near the areas of Copeland, Eastport, and Moyie Springs and other outlying communities.

Summary

The Camp Robin project area has been shaped by past management activities, development, and wildfire. Over the past 70 - 80 years, wildfire suppression has been a priority and has led to natural fires being excluded from the landscape. Fire suppression will continue to be a management direction in the Camp Robin area due to the values in and around the project area. Because fires will continue to be suppressed, management action will be needed to aid in successful fire suppression. Manipulation of fuels and vegetation will allow for protection of human life, property and safety of firefighting resources. Vegetation treatments that reduce fuels will not stop wildfires (Finney and Cohen 2003). However, modifying or removing fuels that contribute to high fire severity, such as heavy dead and down wood, ladder fuels, and dense canopy fuels, while incorporating fire back into the system would reduce potential mortality in residual, large mature trees and help create fire-resilient stands (Agee and Skinner 2005).

The no-action alternative would not address the purpose and need of the project to reduce wildfire risk to local communities and surrounding federal lands and protect critical infrastructure and primary egress routes. Fuels would continue to accumulate and contribute to the hazards to firefighting resources. Over time as fuels continue to build up, the potential for severe fire behavior would increase. Potential flame lengths and risk of crown fire increase every year without some sort of vegetation treatment. In the instance of a severe wildfire, suppression forces would have fewer options on how to control a wildfire and it may affect large areas and infrastructure in and around the Camp Robin project area.

The proposed action is designed to meet the goals of the Camp Robin Project. This alternative would reduce fuel loading and canopy bulk density while increasing the canopy base heights. These changes in the fuel characteristics would result in lower flame lengths and a lower probability of crown fire activity across the landscape. The proposed action would reduce fuel loads and create larger openings, thus creating a reduction in fire hazard in the Camp Robin project area. The fuel reduction activities would provide firefighters more safe and effective opportunities to suppress and manage wildfires that occur in the Camp Robin project area with an overall higher probability of success.

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